Wind Turbine Reliability Engineering Training Course

Professional Development Training Course Outline

Category	Renewable Energy	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Wind Turbine Reliability Engineering Training Course is designed to equip professionals with advanced capabilities for improving wind turbine reliability, availability, maintainability, and lifecycle performance. The course focuses on the modern reliability landscape across onshore and offshore wind, integrating condition monitoring, predictive maintenance, prognostics and health management (PHM), failure-mode analysis, reliability-centered maintenance (RCM), SCADA analytics, vibration analysis, remaining useful life (RUL) estimation, and asset performance management (APM). Current industry research increasingly emphasizes AI-enabled diagnostics, digital twins, real-time data, machine learning, and risk-informed maintenance as important tools for modern wind-turbine O&M.

Participants will develop a practical understanding of how to convert turbine operating data and engineering knowledge into actionable reliability decisions, from identifying critical failure mechanisms to selecting appropriate maintenance strategies and optimizing intervention timing. The course uses realistic gearbox, bearing, generator, blade, drivetrain, structural, and offshore integrity case studies, allowing learners to connect reliability theory with operational decision-making. Contemporary wind-turbine condition monitoring increasingly combines SCADA data, high-frequency vibration and acoustic analysis, machine learning, and digital-twin frameworks, making these capabilities particularly relevant to modern renewable-energy asset management.

Programme Curriculum

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Course Objectives

By the end of the course, participants will be able to:

1. Apply reliability engineering principles to wind turbine systems and critical components.
2. Develop Failure Mode, Effects and Criticality Analysis (FMECA/FMEA) for turbine assets.
3. Implement Reliability-Centered Maintenance (RCM) and risk-based maintenance strategies.
4. Analyze SCADA data for performance degradation and early fault detection.
5. Apply condition monitoring techniques including vibration, acoustic, thermal, oil, and structural monitoring.
6. Use predictive maintenance and machine-learning analytics to support maintenance decisions.
7. Understand digital twin architectures for reliability, diagnostics, prognostics, and O&M optimization.
8. Evaluate Remaining Useful Life (RUL) and degradation trends for critical components.
9. Develop asset health indicators and reliability-based maintenance priorities.
10. Optimize maintenance intervals, resource allocation, downtime, and lifecycle cost.
11. Apply probabilistic risk assessment and uncertainty management to wind-turbine reliability.
12. Integrate AI, IoT, edge analytics, and data-driven prognostics into reliability programs.
13. Develop practical asset performance management and continuous-improvement strategies for wind farms.

Target Audience

1. Wind Turbine Reliability Engineers
2. Maintenance and O&M Engineers
3. Wind Farm Asset Managers
4. Condition Monitoring and Predictive Maintenance Specialists
5. Mechanical, Electrical, and Renewable Energy Engineers
6. Wind Farm Operations Managers and Supervisors
7. Reliability, Maintenance Strategy, and Asset Performance Professionals
8. Engineering consultants, technical advisors, and professionals involved in onshore/offshore wind projects

Course Modules

Module 1: Wind Turbine Reliability Engineering Fundamentals

- Reliability, availability, maintainability, and failure-rate fundamentals
- Wind turbine architecture
- Weibull analysis, bathtub curves, MTBF, MTTR, and reliability growth
- Failure mechanisms and reliability drivers in onshore and offshore environments
- Case Study: Reliability assessment of a wind farm experiencing recurring gearbox and bearing failures

Module 2: Failure Analysis, FMEA/FMECA and Criticality Assessment

- Structured FMEA/FMECA methodology for wind turbine systems
- Failure modes, causes, effects, detection methods, and criticality ranking
- Risk-based prioritization of high-consequence components
- Failure-data collection, bad-actor analysis, and root-cause investigation
- Case Study: Criticality assessment of 300+ offshore wind turbine failure modes and selection of high-value monitoring targets, reflecting established risk-based approaches in offshore wind.

Module 3: Reliability-Centered and Predictive Maintenance

- Reliability-Centered Maintenance (RCM) decision logic
- Preventive, predictive, condition-based, corrective, and proactive maintenance
- Maintenance optimization using risk, failure probability, consequence, and cost
- Predictive maintenance workflows and maintenance-trigger development
- Case Study: Moving from fixed-interval gearbox servicing to condition-based maintenance using component health indicators

Module 4: Condition Monitoring and Fault Diagnostics

- Vibration analysis for bearings, gears, shafts, and drivetrain components
- Oil/debris analysis, thermography, acoustics, strain, and structural health monitoring
- SCADA-based condition monitoring and anomaly detection
- Fault signatures, alarms, thresholds, trends, and diagnostic confidence
- Case Study: Detecting an emerging drivetrain fault using SCADA trends combined with vibration and acoustic indicators; these are among the monitoring approaches highlighted in current drivetrain research.

Module 5: Data Analytics, AI and Machine Learning for Reliability

- Wind-turbine data engineering, preprocessing, feature extraction, and anomaly detection
- Machine learning for fault classification, prediction, and degradation modeling
- Time-series analytics and early-warning systems
- Explainable AI, model validation, data quality, and false-alarm management
- Case Study: Developing an AI-based early-warning model for gearbox degradation using historical turbine data

Module 6: Digital Twins, Prognostics and Remaining Useful Life

- Digital Twin concepts, architectures, data integration, and maturity
- Physics-based, data-driven, and hybrid digital-twin models
- Prognostics and Health Management (PHM) workflows

- Remaining Useful Life (RUL) estimation and uncertainty quantification
- Case Study: Probabilistic digital twin for offshore wind maintenance optimization using real-time environmental and operational data.

Module 7: Offshore Wind Reliability and Structural Integrity

- Offshore-specific reliability challenges
- Structural integrity of towers, foundations, blades, and offshore support structures
- Corrosion-fatigue prognosis and inspection planning
- Weather-window constraints, vessel logistics, and offshore maintenance risk
- Case Study: Probabilistic digital-twin assessment of corrosion-fatigue in a floating offshore wind turbine, demonstrating how updated failure probabilities can support maintenance planning.

Module 8: Reliability Optimization, Asset Performance and Lifecycle Management

- Asset Performance Management (APM) and reliability dashboards
- Availability, downtime, OEE-style performance indicators, and lifecycle cost optimization
- Reliability-based maintenance planning and resource optimization
- Risk-informed decision-making and continuous reliability improvement
- Case Study: Creating a reliability improvement roadmap that integrates condition monitoring, digital twins, predictive maintenance, and maintenance-resource planning into a closed-loop O&M process.

Training Methodology

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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